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NEW TRACTION DRIVES COULD REPLACE GEARS, REVOLUTIONIZE POWER TRANSMISSION

After more than six years of research and testing, a team of engineers at the NASA Lewis Research Center, Cleveland, reports it is close to achieving a major advance in power transmission.

The development, known as the Nasvytis multiroller traction drive, is based on a concept of Dr. Algirdis L. Nasvytis. NASA Lewis reports that its new drive is able to transmit high power loads at high speed ratios without the use of toothed gears and could replace gears in a broad range of applications.

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NASA engineers, working in conjunction with Dr. Nasvytis, have made several key design changes in the traction drive roller geometries, resulting in successful operation of a 15-to-1 speed ratio drive in a test rig. Lewis alsc has successfully demonstrated a similar drive for an automotive gas turbine engine.

The traction drive shows promise of transmitting 7 horsepower per pound as opposed to conventional gears which operate in the vicinity of 4 horsepower per pound.

NASA engineers believe that the new drive, on a commercial basis, could find almost immediate application in the machine tool industry where -- in the case of grinders and millers -- ultra-high speeds could be achieved to produce vastly improved product quality and increased rates of production.

Similarly, in high-speed drive systems normally powered by gas turbines, the Nasvytis drive, as a speed increaser married to a conventional alternating-current electric motor, could accomplish the same results in a far simpler and less expensive manner.

As a replacement for both geared drives and conventional traction drives, multiroller traction drives could be used for other power transmission applications including automotive gas turbine engine drive trains, helicopter main rotor transmissions, aircraft drive systems, rocket engine turbopump drive systems, wind turbines and high speed turbomachinery.

Just as the internal combustion engine in aviation gave way to the jet engine, so, too, power transmission gears may step aside for multiroller traction drives to transmit power in industrialized applications of the future.

According to Stuart H. Loewenthal, lead engineer for Lewis on the multiroller traction drive project: " We are just now beginning to find out exactly what these drive systems can and cannot do. Ultimately, this quiet, almost vibrationless means of transmitting power also could make a major contribution to minimizing the noise pollution that now surrounds us."

Loewenthal has been assisted in the project by engineers Neil Anderson of the Army Propulsion Laboratory at Lewis and Douglas A.Rohn, also of Lewis. The drive is commercially available under the name "Nasvytrac" through a company founded by Dr. Nasvytis, known as NASTEC, Inc., Cleveland.

The traction drive idea itself is not new. Between 1879 and 1971 about 34 patents were issued to cover various fixed-ratio traction drive concepts. Of these, eight have been issued to Dr. Nasvytis.

Instead of gears, the Nasvytis traction drives are composed of a "planetary" cluster of smooth cylindrical rollers, bearing directly against one another. This configuration includes a "sun" roller in the center, two rows or more of "planet" rollers surrounding the sun roller and a solid "ring" roller enclosing the total complex. By introducing power to either the outer ring or to the central sun roller, one creates, in the former case, a speed increaser and, in the latter, a speed reducer.

Though approximately 20 different types of adjustable speed traction drives are available from a dozen or so U.S. and foreign companies, their widest use has been in Europe with increasing recent interest coming from Russia and Japan. Until now, these conventional drives have been limited to light-duty assignments. The vast majority of those in use today handle loads no greater than 15 horsepower; some have a maximum power rating of 100 horsepower, but are not extremely popular because they weigh from 590 to 1,905 kilograms (1,300 to 4,200 pounds) to achieve this power capacity.

Experience has shown that Nasvytis fixed-ratio traction drives are as efficient as, and less expensive and quieter than, their geared counterparts but the single row format they had employed for nearly 90 years has not only severely restricted their horsepower capacity, but also limited their speed-ratio capability to about 7 to 1.

In 1966, Dr. Nasvytis added two or three rows of variable diameter planet rollers to the system, freeing the concept for expanded power loads and speed ratio ranges.

The Loewenthal team at Lewis, after thousands of manhours of work, have confirmed a number of advantages that make this new version of the Nasvytis traction drive a highly attractive alternative to conventionally geared speed changers:

o For many applications they are simpler and less expensive to manufacture because they require no gear tooth design or cutting. In fact, the tolerances for their roller components are well within ordinary machine grinding limits.

o Because of their unique load balance geometry, they are lighter and smaller than conventional gear boxes and speed changers. A Nasvytis drive can easily be built to handle more than 500 horsepower and yet weigh only between 36 and 180 kg (80 and 400 lbs) depending on speed ranges and duty cycles.

o They are as efficient as gear systems. In a recent NASA test, they performed at a measured efficiency of more than 95 per cent at speeds to 73,000 rpm for 15 to 1 ratio.

o They are more reliable and less susceptible to breakdown and wear. Through the use of special traction fluids, their rollers never actually touch each other -- the fluid provides a miniscule separation -- which serves to virtually eliminate roller wear in addition to damping out drive line vibrations.

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